6/2/2020

TRANSPORTATION MACROECONOMIC ACCOUNTING MODELS: VISION AND NON-LIGHT DUTY ENERGY AND GREENHOUSE GAS (GHG) EMISSIONS ACCOUNTING TOOL (NEAT)

YAN (JOANN) ZHOU
Principal Analyst/Group Lead
Argonne National Laboratory

U.S. DEPARTMENT OF ENERGY Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

OVERVIEW

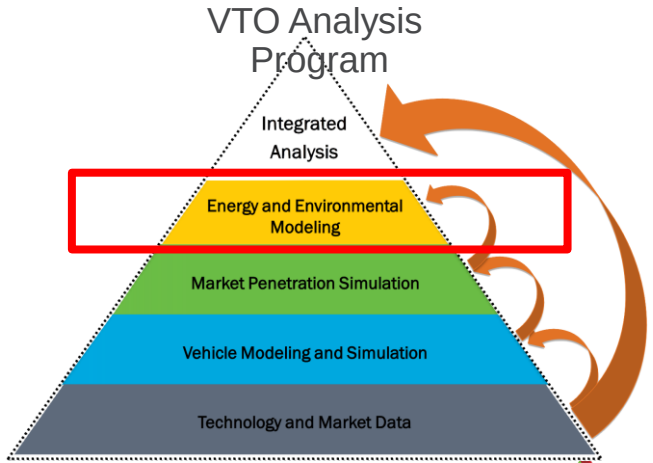
Timeline	Barriers
• Project start date: 10/01/2019 • Project end date: 09/30/2020 • Percent complete: 60%	• Indicators and methodology for evaluating environmental sustainability • Evaluate energy and emission benefits of vehicle/fuel systems • Overcome inconsistent data, assumptions, and guidelines
Budget	**Partners**
• Funding for FY18: $150 K • Funding for FY19: $250 K	National labs: • NREL (Alicia Birky) • ORNL (Stacy Davis)

RELEVANCE AND OBJECTIVES

Need analytical modeling capabilities to compare and evaluate fleet impact of vehicle and fuel technologies by employing consistent, systematic approaches and methodologies.

Objectives: VISION/NEAT, have been developed to provide estimates of the potential energy use, oil use, and carbon emission impacts of advanced light-duty vehicles (LDVs), medium-duty vehicles (MDVs), heavy-duty vehicles (HDVs), and freight modes, as well as alternative fuels, at the national level.

- **Annually update and calibrate VISION/NEAT** models with projections from the Energy Information Administration's Annual Energy Outlook (AEO) reference case and the Department of Transportation's Freight Analysis Framework (FAF)
- **FY20-21: Enhance the medium- and heavy-duty (MDHD) modeling capabilities**
- **FY21-22: Add heterogeneity to the model** by adding flexible inputs for new mobility patterns and demographic variation.

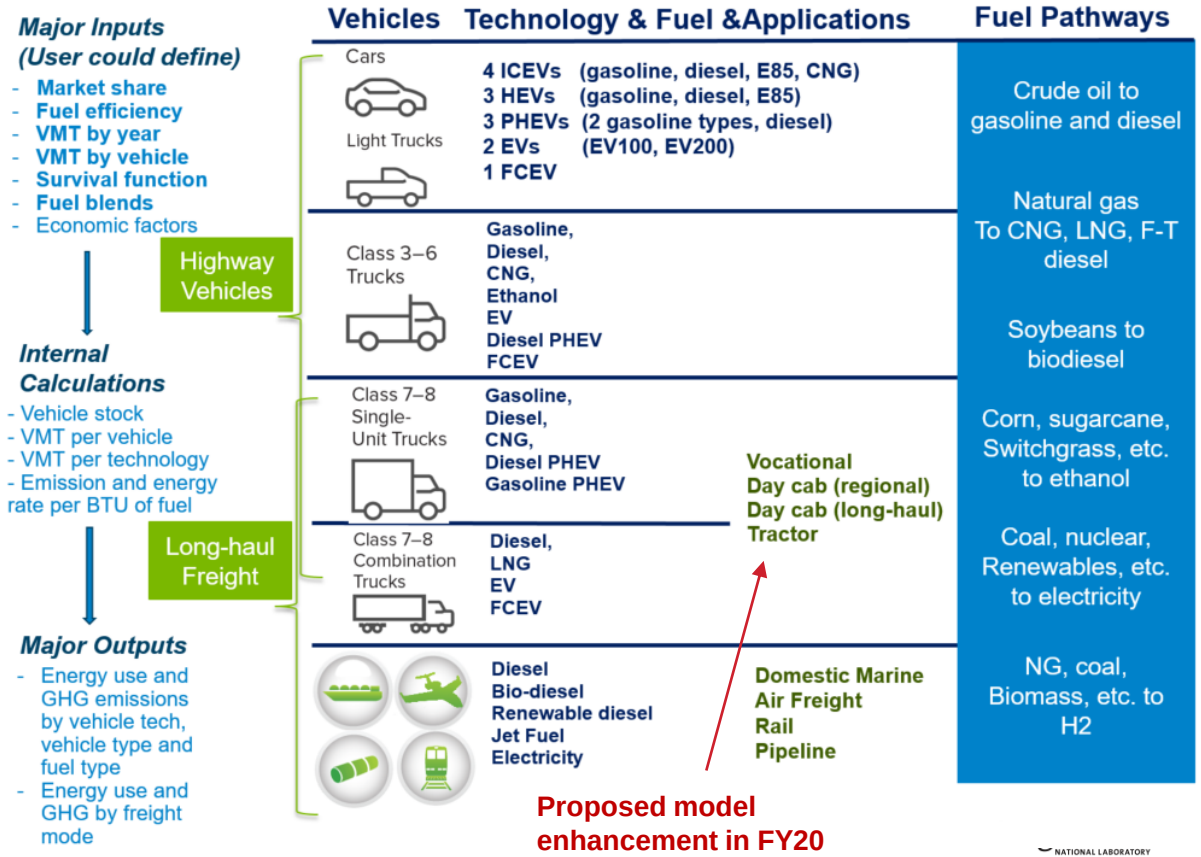


APPROACH: VISION/NEAT Fleet Impact Model Structure

Systematically assess energy and emission effects of vehicle technology deployment scenarios

- Argonne has been developing the VISION/NEAT models since 2000 with annual expansions;
- **Annually updated** using energy/emission rates from GREET®
- **Allow users to define mobility parameters** such as annual VMT per vehicle, vehicle survival functions, etc.*
- **Available to public** at https://www.anl.gov/es/vision-model

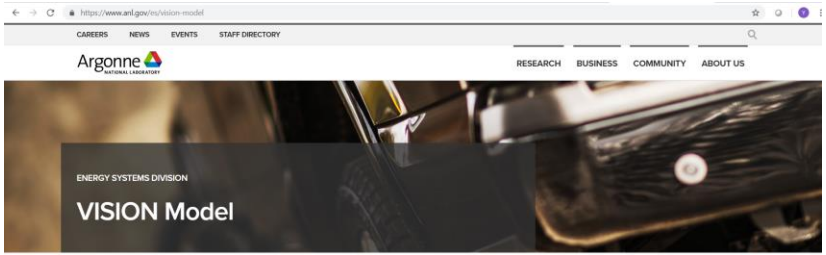
* Available by the end of FY20



FY19-20 ACCOMPLISHMENTS

Annual updated, calibrated and released to the users

- **Maintained a database of historical data:** sales, stock, MPG, VMT, fuel price, etc.
- **Updated and calibrated** to match with **AEO 2020** reference case
- **Updated** with energy and emission intensities from **GREET**1_2019



Estimating energy demand and GHG emissions from non-light duty freight modes through 2050

ES Division

- **Developed VISION-online** to improve user experience
  - Car/LT market shares
  - Car/LT fuel economy
  - PHEV range
  - Utility scenarios

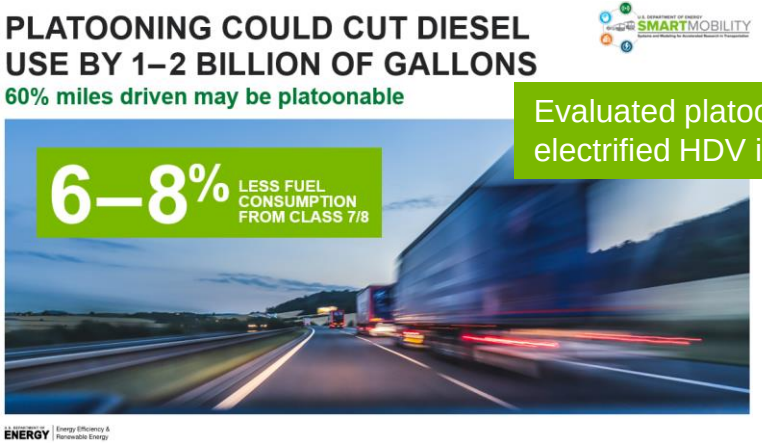
Vision.es.anl.gov

Argonne NATIONAL LABORATORY

FY19-20 ACCOMPLISHMENTS

RESULTS ARE EXTENSIVELY USED BY DOE PROGRAMS AND OTHER AGENCIES

- The models were released to public and available to download online
- The model are widely in several DOE/EERE programs and activities to evaluate the impacts of advanced vehicle and mobility technologies
  - VTO Baseline and Scenario analysis
  - SMART Mobility
  - H2@Scale
- Over 400 users



Evaluated platooning and electrified HDV in SMART

Evaluated electrified HDV in SMART

FY 20 ENHANCEMENT PLAN: FURTHER SEPARATE CLASS 7&8 TRUCK BY SEGMENT

Annual Update and enhancement

Enhance the medium- and heavy-duty (MDHD) modeling capabilities to

- Better align with emerging technologies and trends, the growing DOE MDHD R&D portfolio,
- Better align with EPA / NHTSA regulations in MDHD sector
- Better align with EIA's NEMS model and improve the correction factors in VISION, which are used to calibrate the model to match EIA projections (Correction Factor = EIA projections/VISION projections)

Current Segments
Class 7&8 Single Unit (SU)
Class 7&8 Combination

Proposed Segments
Class 7&8 SU (Vocational)
Class 7&8 Day Cab
Class 7&8 Sleeper

COLLABORATION AND PROPOSED RESEARCH

Collaboration

- NREL: assists on data sources and methodologies
  - Provided NEMS input data files
  - Provided analysis of VIUS VMT data
  - Collaborate on calibrating segmented scrappage and VMT to class totals
- ORNL: provides historical data on vehicle stock, sales and VMT

Proposed Research *(Note: Any proposed future work is subject to funding levels)*

- Continue the effort enhancing the MD/HDV modeling capabilities
  - FY19 work focus on developing model structure first.
  - improving over time with more data becomes available
- Heterogeneity Enhancement
  - **Add heterogeneity** to the model by adding inputs for new mobility patterns that alter the average characteristics: annual/lifetime VMT, survival function, vehicle efficiency
  - **Allow users to generate scenarios based on assumptions** about variables such as vehicle population in urban areas, technology performance and adoption, mobility choice, and induced travel demand

SUMMARY

- **Objectives:** develop analytical modeling capabilities to compare and evaluate fleet impact of vehicle and fuel technologies by employing consistent, systematic approaches and methodologies.
- **Outcomes:** publicly available models to provide estimates of the potential energy use, oil use, and carbon emission impacts of highway technologies, and alternative fuels, at the national level.
- **Methods:** Annually updated and calibrated to match with projections with AEO and FAF. Adopts latest energy and emission rates from GREET model. FY20 focus on summarizing vehicle usage and survival patterns of MD/HDV
- **Results:** release the models on Argonne's websites and support other DOE programs
- **Publications:** User guide and reports to document data and methodologies
- **Milestones:** Successful quarterly, and annual milestones delivered on-time and within budget – improving over time with more data becomes available

TECHNICAL BACK-UP SLIDES

VISION MDHD ENHANCEMENT PLAN

Where the data come from

	Sales		Stock		VMT	
	Historical	**Projections**	**Historical**	**Projections**	**Historical**	**Projections**
Class 7&8 SU (vocational)	Estimate using POLK registration by model year	NEMS, (from IHS Global Insight macro model)	Distribution of truck segment using POLK registration	NEMS	FHWA	VMT/vintage * Stock, NEMS (based on Global Insight macro projection)
Class 7&8 Day Cab						
Class 7&8 Sleeper						

- Historical VMT: FHWA reports VMT by SU and combination unit. The VMT/vintage by segment will be proportionally adjusted to match the total VMT from FHWA
- Data availability could improve over year. The objective here is to develop model infrastructure first.

VISION MDHD ENHANCEMENT PLAN (CONT')

Where the data come from

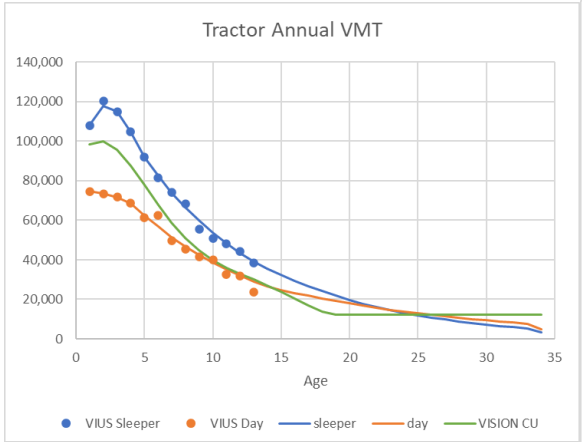
	Efficiency		Survival Function		VMT/vintage	
	Historical	Projections	Historical	Projections	Historical	Projections
Class 7&8 SU	VIUS and EPA regulation	NEMS	Developed using POLK registration by model year		VIUS	
Class 7&8 Day Cab						
Class 7&8 Sleeper						

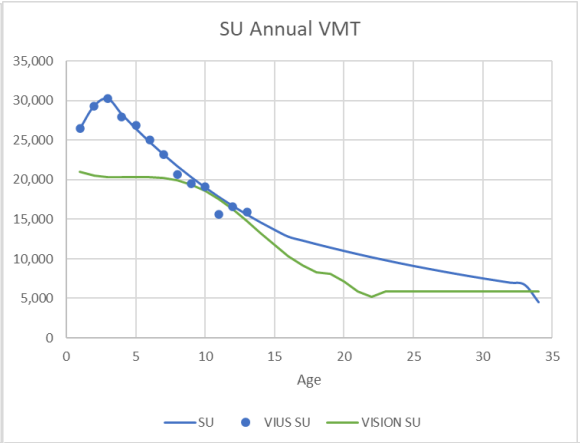
- Historical vehicle efficiency: use VIUS for model year prior to 2002. NEMS input file, 2002-2009. Then use EPA / NHTSA regulations for baseline assumptions and standards 2010-2018, assuming that OEMs met the regulations
- Projected vehicle efficiency: NREL and EIA provides the data (Inputs used in AEO 2018)
- VMT/vintage could be different by powertrain, will be adjusted to match total VMT from FHWA (historical) and NEMS (projections)

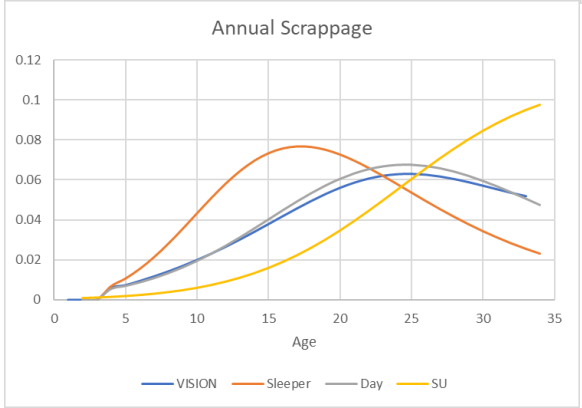
FY 20 ENHANCEMENT PLAN: INITIAL DATA ANALYSIS

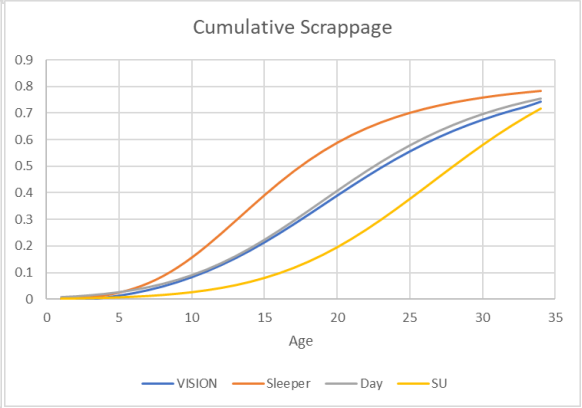
Analysis of VIUS and IHS Polk data used to segment sales, estimate VMT schedules and calibrate scrap rates to obtain similar:

- Historical stock distribution by age
- Median age (age where 50% of vehicles are scrapped)
- Lifetime VMT
- Total stock and VMT









SLIDES FOR REVIEWERS

CRITICAL ASSUMPTIONS AND ISSUES

- Rely on projections made by EIA's AEO and DOT's FAF, which may or may not fully capture the impacts of new technology trend and uncertainties on vehicle sales, stock, efficiency and VMT
- Reply on available national data, such as the Vehicle Inventory and Use Survey (VIUS), which was conducted every 5 years from 1967-2002. It was discontinued after 2002. It included detailed data on the characteristics of the nation's truck population and truck activity.
- Use EPA / NHTSA regulations for baseline assumptions and standards 2010-2018, assuming that OEMs met the regulations

PUBLICATIONS

- In the process of developing an updated model user guide and an Argonne reports to document method and data used to enhance MD/HDV model capabilities

THANK YOU

YZHOU@ANL.GOV